BELLCOMM, INC.
1100 Seventeenth Street, N.W. Washington, D.C. 20036

SUBJECT: Observed Performance of The Operational Intercommunication System OIS(RF) During Prelaunch Tests and Countdown of Apollo 4 Case 900

DATE: November 28, 1967

FROM: J. T. Raleigh

ABSTRACT

The Operational Intercommunication System (OIS) at Launch Complex 39 is a system which transmits 112 individual voice channels in a radio system over coaxial cables and is known as the OIS-RF system. The AS-501 launch and its earlier tests were the first major use of this system. Because of a major concern about the quality of voice communications, the tests were monitored with a view to the system performance and its support of the tests.

Following the Countdown Demonstration Test, it became apparent that the multiple station monitors (major KSC personnel and MCC-H personnel) noted more objectional performance than was noted at a conventional two channel unit.

As a result, monitors at both KSC and MCC-H were employed. In general, the OIS system performed quite well. Some of the apparent problems, such as locking microphone keys, were recognized prior to the tests and plans are underway for their solution. During the course of the tests, a marked improvement in OIS performance, such as reduced noise, was noted. The final day of the CDDT and Launch exhibited the best performance. Some problems with variation in OIS voice levels and with trouble shooting procedures were noted, but most of these problems were recognized during the tests and improvements initiated.

Apollo 4 was the first major mission employing the OIS-RF system, and except for a few major outages during tests, the system worked quite well. The squelched OIS-RF receiver can produce objectional noise. A number of comments on this were made at consoles where many loops were monitored at the same time. This noise seemed to monotonically decrease as the tests progressed.

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MEMORANDUM FOR FILE

INTRODUCTION

The Operational Intercommunication System (Radio Frequency) OIS(RF) at KSC was monitored during the tests prior and during the launch of Apollo 4. Bellcomm (MOS) and NASA Headquarters (MOG) personnel continuously monitored an OIS(RF) station in the Communication Control Room (CCR) of Launch Complex 39 during the Apollo 4 Countdown Demonstration Tests (CDDT). During the Flight Readiness Test (FRT) several consoles in Firing Room #1 (FR-1) and the Operations Management Room (OMR) were monitored at different times. MOS observers also monitored the OIS channels as received at MSC at a console in the Support Room at the Mission Control Center in Houston (MCC-H) during the FRT. During the Launch Countdown on November 8-9, 1967, this position at MCC-H and the CCR position at LC 39 were used to monitor the OIS system performance. In addition, tape recordings made at MCC-H during the CDDT have been analyzed to determine the apparent performance of the OIS(RF) channels as heard at MCC-H. This memorandum summarizes the major observations made during the tests.

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Observations at KSC During Countdown Demonstration Test

During the CDDT, the observations in the CCR were made at a standard OIS-RF station which was designed to permit active communications on a single channel and monitoring on a second channel. Thus, as with most of the users, observers were able to monitor any two of the 112 channels on the OIS-RF system. The standard observer procedure was to cycle thru all channels in use periodically. As observed at this station, the performance appeared to be quite good, although complaints about noisy channels were overheard such as those mentioned by the MSC personnel at the Flight Readiness Review; these major noise problems were not apparent at the CCR monitoring point.

Early in the CDDT, a number of noisy channels were breaking squelch when no conversation was taking place. This was apparently caused by both noise sources and voice splatter from adjacent channels.

There also appeared to be quite a few OIS user mistakes which included (a) open microphones caused by transmit keys held or locked open (b) loudspeakers in the vicinity, (c) talking on one loop and listening on a second loop, (d) improper positioning of microphones and headsets, (e) delays in reporting channel troubles and (f) the use of nonstandard end instruments.

The UHF radio links with the Transporter and Mobile Service Structure (MSS) produced a great deal of static-like noise when the MSS was being moved the first time during the CDDT. These links were not used the second time the MSS was moved.

The failure of the modems (connectors?) which occurred a few times is a significant failure mode in the OIS-RF system and merits careful attention. The point-to-point telephones and the private loops, which in general were used to avoid traffic on the OIS(RF), were also very useful for back-up purposes.

The Supervisor of Range Operations (SRO) was noted to be working in an area of excessive noise. Several observers recorded that both SRO and the MILA USB station appeared to be operating at a noticeably higher voice level than other OIS stations.

During the CDDT no Bellcomm observers were stationed at MCC-H. Some tape recordings made at MCC-H were obtained that contained the OIS channels as heard at MCC-H. In general, as noted earlier, the multiple (more than two) monitor stations such as the Type 51 units at KSC and the consoles at MCC-H had a more objectionable noise level.

The overall OIS performance seemed to improve during the course of the CDDT up to and including the last day on which the general performance was quite satisfactory. This was also noted at MCC-H, as reported at the Flight Readiness Review.

Observations Made at KSC During the Flight Readiness Test (FRT)

During the FRT, the OIS was monitored at KSC at different times from several positions in the Operations Management Room (OMR) and from the first tier consoles (when available) in Firing Room 1. The stations in the OMR allowed access to four OIS channels and to the Type 51 Units (configured for specific requirements) which allowed access to up to 18 or 20 different OIS channels. Bellcomm personnel also monitored OIS-RF lines which appeared at MSC in a Support Room adjacent to the Control Room at MCC-H.

In several cases it was noted that the quality of a channel appearing at a Firing Room console was better than that observed on the same circuit in the OMR. In some cases, the quality of an OIS-RF channel on the RF side of the Type 51 Unit appeared to be better than that on the same circuit when it appeared on the push button (four-wire) side of the same console.

There is no doubt that since OMR stations and the Type 51 Units permit simultaneous monitoring of many loops, a noise level that would not be annoying on a standard OIS station (that would permit two channels to be monitored simultaneously) could become very disturbing on a Type 51 Unit. At KSC, the Type 51 Units allow wide volume adjustment of each channel. One should be very careful in the selection and adjustment (if required) and keep the number of monitored channels to the minimum required.

There was an apparent tying together of two major OIS channels (#111 and #121) at about T-17 minutes of the FRT which caused problems in the conduct of the test. Another significant difficulty was loss of a major OIS-RF circuit (#212) to MCC-H which later was attributed to a "304 Switcher Problem."

Also during this test, it was noted by the writer (and also mentioned by Mr. Jack King) that the use of the OIS headset through a Type 51 Unit into the standard telephone lines produced a number of comments about poor quality at the other end of the line. This may be due to a marked difference in end instrument characteristics.

Observations Made at MCC-H During the Flight Readiness Test

At MCC-H it was possible to monitor several loops at a time, and most of the loops were part of a four-wire system. When monitoring OIS-RF channels from KSC there was often a longer and rising noise level when the squelch level was broken. There also appeared to be a considerable amount of cross talk on the OIS circuits which had appearances at MCC-H. It should be noted the MCC-H stations do not have individual line volume controls, only a headset master volume control.

Several observations were made at MCC-H when parties at KSC were discussing problems about "breaking up" and the need to repeat their conversations. At these times, the MCC-H could hear both sides of the conversation without any apparent difficulty. Conversely there were periods on the same loops when it was very difficult to monitor because of low signal levels yet the parties at KSC were apparently not experiencing any difficulty in communicating with one another.

OIS Observations at KSC During Apollo 4 Launch Countdown

For the launch count, the multiple OIS stations were used by the operational personnel and the OIS monitoring at KSC was done from the same location in the CCR of LC 39 as was used for the CDDT. In general, the OIS system performance was quite good. Only two problems were noted at KSC:

(1) The external HF radio interference on channel 112 when the OIS circuits were connected to the pad was very noticeable and disturbing.

(2) The post lift-off channel assignments and communications system monitoring were inappropriate. The use of some channels for relay of MSFN and MCC-H mission conduct would be useful to KSC personnel.

OIS Observations at MCC-H During Apollo 4 Launch Countdown

In general, the overall OIS communications were greatly improved as observed at MCC-H. Two of the major channels merited comments. Channel 121 had a marked variation in speaker levels (some low, others loud and mushy) and Channel 212 subjectively appeared to be the most noisy.

General Summary of OIS Observations

The overall OIS communications were generally quite good and improved with time. Major problems were associated with the locked microphone keys and user practices. Some of the communications outages were annoying and ill timed. A wide variation in the time required for reporting and location of trouble and in the restoration of service was noted.

Some of the complaints about ground voice communications appear to be related to audio line transmission problems that are not caused by the RF implementation of the OIS at Launch Complex 39 and the Manned Spacecraft Operations Building.

The control of the overall signal levels and the location and evaluation of the noise sources should be actively continued.

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J. T. Raleigh

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From: J. T. Raleigh

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